

What is claimed is:

1. A light emitting diode (LED) lamp for mounting to an existing fixture for a fluorescent lamp having a ballast assembly including ballast opposed electrical contacts, comprising:

a tubular wall generally circular in cross-section having tubular wall ends,
at least one LED positioned within said tubular wall between said tubular wall ends,

electrical circuit means for providing electrical power from the ballast assembly to said at least one LED, said electrical circuit means including at least one metal substrate circuit board,

means for electrically connecting said electrical circuit means with the ballast assembly,

said electrical circuit means including an LED electrical circuit including opposed electrical contacts,

at least one electrical string positioned within said tubular wall and generally extending between said tubular wall ends, said at least one LED being in electrical connection with said at least one electrical string,

said at least one LED being positioned to emit light through said tubular wall,
means for supporting and holding said at least one LED and said LED electrical circuit, said means for supporting being said at least one metal substrate circuit board positioned within said tubular wall between said tubular wall ends,

means for suppressing ballast voltage being delivered from the ballast assembly to an LED operating voltage within the voltage design capacity of said at least one LED,

said means for suppressing ballast voltage being in electrical connection with said electrical circuit means,

said at least one metal substrate circuit board including opposed means for connecting said at least one metal substrate circuit board to said tubular wall ends, and

said tubular wall ends including means for mounting said means for connecting and said at least one metal substrate circuit board.

2. The LED lamp as set forth in claim 1, wherein said opposed means for connecting said at least one metal substrate circuit board to said tubular wall ends includes said at least one metal substrate circuit board having opposed tenon connecting ends and wherein said means for mounting includes each of said tubular wall ends defining a mounting slot, said tenon connecting ends being positioned in said mounting slots.

3. The LED lamp as set forth in claim 2, wherein said at least one LED is a plurality of LEDs.

4. The LED lamp as set forth in claim 3, wherein said at least one metal substrate circuit board is distanced from said tubular wall, said tubular structure and said tubular wall forming an elongated space between said tubular wall ends, said plurality of LEDs being positioned in said elongated space.

5. The LED lamp as set forth in claim 4, wherein said at least one electrical string

includes a plurality of electrical strings mounted to said at least one metal substrate circuit board.

6. The LED lamp as set forth in claim 5, wherein said plurality of LEDs are electrically connected to said plurality of electrical strings.

7. The LED lamp as set forth in claim 1, wherein said at least one LED is at least one high-brightness LED.

8. The LED lamp as set forth in claim 7, wherein said at least one high-brightness LED is a plurality of high-brightness LEDs.

9. The LED lamp as set forth in claim 1, wherein said at least one LED is a surface mount device (SMD) LED.

10. The LED lamp as set forth in claim 9, wherein said at least one LED is a plurality of SMD LEDs.

11. The LED lamp as set forth in claim 1, wherein said tubular wall includes at least one curved portion.

12. The LED lamp as set forth in claim 1, wherein said ballast assembly is an instant start ballast assembly having ballast opposed single-pin electrical contacts

mounted in ballast opposed single-pin sockets.

13. The LED lamp as set forth in claim 12, wherein said means for electrically connecting said electrical circuit means with the ballast assembly includes opposed electric circuit single-pin electrical contacts mounted in said ballast opposed single-pin sockets in electrical contact with said ballast opposed single-pin electrical contacts.

14. The LED lamp as set forth in claim 13, wherein said electrical circuit means includes single-pin integral electronics circuitry having a bridge rectifier for converting AC voltage received from said ballast assembly to DC voltage.

15. The LED lamp as set forth in claim 14, wherein said single-pin integral electronics circuitry further includes said means for suppressing ballast voltage, said means for suppressing ballast voltage being at least one voltage surge absorber.

16. The LED lamp as set forth in claim 15, wherein said single-pin integral electronics circuitry further includes a fuse for providing current protection to said LED electrical circuit and for de-energizing said LED electrical circuit in the event the current being delivered exceeds the maximum current limit of said ballast circuitry.

17. The LED lamp as set forth in claim 16, wherein said single-pin integral electronics circuitry further includes at least one resistor for limiting the current received by said at least one LED from the ballast assembly.

18. The LED lamp as set forth in claim 1, wherein said ballast assembly is a rapid start ballast assembly having ballast opposed bi-pin electrical contacts mounted in ballast opposed double contact sockets.

19. The LED lamp as set forth in claim 18, wherein said means for electrically connecting said electrical circuit means with the ballast assembly includes opposed electric circuit bi-pin electrical contacts mounted in said ballast opposed double contact sockets in electrical contact with said ballast opposed bi-pin electrical contacts.

20. The LED lamp as set forth in claim 19, wherein said electrical circuit means includes bi-pin integral electronics circuitry having a bridge rectifier for converting AC voltage received from said ballast assembly to DC voltage.

21. The LED lamp as set forth in claim 20, wherein said bi-pin integral electronics circuitry further includes said means for suppressing ballast voltage, said means for suppressing ballast voltage being at least one voltage surge absorber.

22. The LED lamps set forth in claim 21, wherein said bi-pin integral electronics circuitry further includes a fuse for providing current protection to said LED electrical circuit and for de-energizing said LED electrical circuit in the event the current being delivered exceeds the maximum current limit of said ballast circuitry.

23. The LED lamp as set forth in claim 22, wherein said bi-pin integral electronics circuitry further includes at least one resistor for limiting the current received by said at least one LED from the ballast assembly.

24. The LED lamp as set forth in claim 2, wherein said at least one metal substrate circuit board includes a conductive circuit layer, a metal base layer, and a dielectric layer positioned between said conductive circuit layer and said metal base layer.

25. The LED lamp as set forth in claim 24, wherein said metal base layer includes said opposed tenon connecting ends.

26. The LED lamp as set forth in claim 25, wherein said dielectric layer is electrically non-conductive and thermally conductive.

27. The LED lamp as set forth in claim 26, wherein said at least one LED is mounted to said conductive circuit layer.

28. The LED lamp as set forth in claim 27, wherein said at least one LED includes a light emitting lens portion, a body portion, and a base portion, wherein said base portion is mounted proximate to said metal substrate circuit board.

29. The LED lamp as set forth in claim 28, wherein said light emitting lens

portion is positioned in juxtaposition with said tubular wall.

30. The LED lamp as set forth in claim 29, wherein said conductive circuit layer includes the electronic components for said at least one LED including traces and pads.

31. The LED lamp as set forth in claim 30, wherein said at least one LED is electrically connected to said electronic components of said conductive circuit layer.

32. The LED lamp as set forth in claim 31, wherein said at least one LED is a plurality of LEDS.

33. The LED lamp as set forth in claim 24, wherein said at least one metal substrate circuit board includes a second metal substrate circuit board.

34. The LED lamp as set forth in claim 33, wherein said second metal substrate circuit board includes a second conductive circuit layer, a second metal base layer, and a second dielectric layer positioned between said second conductive circuit layer and said second metal base layer.

35. The LED lamp as set forth in claim 34, said second metal base layer has second opposed tenon connecting ends and each of said tubular wall ends include second opposed mounting slots, said second opposed tenon connecting ends being positioned in said second opposed mounting slots.

36. The LED lamp as set forth in claim 34, wherein said second dielectric layer is electrically non-conductive and thermally conductive.

37. The LED lamp as set forth in claim 36, wherein said second conductive circuit layer includes the electronic components for at least one LED including traces and pads.

38. The LED lamp as set forth in claim 37, wherein said at least one LED is electrically connected to said electronic components of said conductive circuit layer.

39. The LED lamp as set forth in claim 38, wherein said second metal substrate circuit board is opposed to and distanced from said at least one metal substrate circuit board.

40. The LED lamp as set forth in claim 39, wherein said at least one LED is a plurality of LEDs.

41. The LED lamp as set forth in claim 40, further including a heat sink positioned between and connected to said metal substrate circuit board and said second metal substrate circuit board.

42. The LED lamp as set forth in claim 41, further including heat conductive

grease positioned between said second metal base layer and said heat sink.

43. The LED lamp as set forth in claim 41, further including thermal epoxy positioned between said second metal base layer and said heat sink.

44. The LED lamp as set forth in claim 41, further including a Sil-Pad positioned between said second metal base layer and said heat sink.

45. The LED lamp as set forth in claim 33, further including a third metal substrate circuit board.

46. The LED lamp as set forth in claim 45, wherein said third metal substrate circuit board includes a third conductive circuit layer, a third metal base layer, and a third dielectric layer positioned between said third conductive circuit layer and said third metal base layer.

47. The LED lamp as set forth in claim 46, said third metal base layer has third opposed tenon connecting ends and each of said tubular wall ends include third opposed mounting slots, said third opposed tenon connecting ends being positioned in said third opposed mounting slots.

48. The LED lamp as set forth in claim 46, wherein said at least one LED is mounted to said third conductive circuit layer.

49. The LED lamp as set forth in claim 48, wherein said at least one LED is a plurality of LEDs.

50. The LED lamp as set forth in claim 49, wherein said at least one metal substrate circuit board, said second metal substrate circuit board, and said third metal substrate circuit board are configured in a triangular configuration extending between said tubular wall ends.

51. The LED lamp as set forth in claim 1, wherein said tubular wall has a cylindrical outer surface and wherein each said LED center line of said plurality of LED center lines are perpendicular to a tangential plane defined at the area of juxtaposition between said tubular wall and each said LED of said plurality of LEDs.

52. The LED lamp as set forth in claim 1, said at least one LED being at least two LEDs and said at least one electrical string being at least one parallel electrical string comprising two single electrical strings in parallel including at least one LED electrically connected to each single electrical string in parallel of said at least one parallel electrical string, said at least two LEDs and said at least one parallel electrical string being positioned in said elongated space.

53. The LED lamp as set forth in claim 52, wherein said at least one parallel electrical string is a plurality of parallel electrical strings and said at least two LEDs

includes a plurality of LEDs electrically connected to said plurality of parallel electrical strings.

54. The LED lamp as set forth in claim 52, wherein said at least two LEDs include a plurality of LEDs, and wherein each of said plurality of electrical strings in electrical parallel connection includes said plurality of LEDs being mounted to each of said plurality of electrical strings in electrical parallel connection.

55. The LED lamp as set forth in claim 1, wherein said at least one LED in electrical connection with said one electrical string is a plurality of LEDs in electrical series connection within said one electrical string.

56. The LED lamp as set forth in claim 1, wherein said tubular housing is made of a light diffusing material.

57. The LED lamp as set forth in claim 56, wherein said light diffusing material is diffused glass.

58. The LED lamp as set forth in claim 56, wherein said light diffusing material is diffused plastic.